CLAIMS

1. A cross-linked polyether which is obtained by polymerization of at least one monomer selected from the group consisting of

a) (α-X-methyl) vinyl-EWG, (α-X-methyl) vinyl-ERG, or (α-X-methyl) vinyl-aryl, where X is oxygen, sulfur, PEG, PPG or poly (THF);

b) a monomer which is polymerizable with a PEG, PPG or poly (THF) cross-linker having at least one (α-X-methyl) vinyl-EWG, (α-X-methyl) vinyl-ERG or (α-X-methyl) vinyl-aryl, where X is oxygen, sulfur, PEG, PPG, or poly (THF);

c) a PEG, PPG, or poly (THF) cross-linker having at least an acrylamide or a methacrylamide end group; and

d) mixtures thereof.

2. Cross-linked polyether according to claim 1, wherein said monomer is copolymerized with styrene.

3. Cross-linked polyether according to claim 2, wherein said styrene is present in an amount of about 0.01 to about 99.99 %.

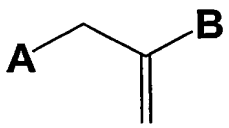
4. Cross-linked polyether according to claim 2, wherein said styrene is present in an amount of about 10 to about 90 %.

5. Cross-linked polyether according to claim 1, wherein said monomer is copolymerized with divinylbenzene.

6. Cross-linked polyether according to claim 5, wherein said divinylbenzene is present in an amount of about 0.01 to about 99.99 %.

7. Cross-linked polyether according to claim 5, wherein said divinylbenzene is present in an amount of about 0.2 to about 50 %.

8. Cross-linked polyether according to any one of claims 1 to 8, wherein said monomer is a polymerizable compound having the general formula



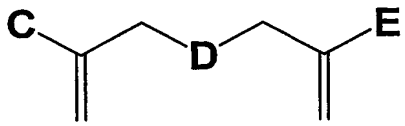
wherein

A represents H, C_1-C_{30} alkyl, C_1-C_{30} aryl, C_3-C_{30} aralkyl, PEG, PPG, poly (THF), hydroxyl, C_1-C_{30} alkyloxy, C_1-C_{30} hydroxyalkyl, amino, C_1-C_{30}, alkylamine, C_1-C_{30} aminoalkyl, formyl, C_1-C_{30} alkylaldehyde, thiol, C_1-C_{30} alkylthiol, halogen or an C_1-C_{30} halogenoalkyl; and

B represents an electron withdrawing group, an electron releasing group or a C_1-C_{30} aryl.

9. Cross-linked polyether according to any one of claims 1 to 8, wherein said monomer is copolymerized with a PEG, PPG, or a poly (THF) based cross-linker.

10. Cross-linked polyether according to any one of claims 1 to 8, wherein said monomer is copolymerized with a secondary cross-linker of the general formula



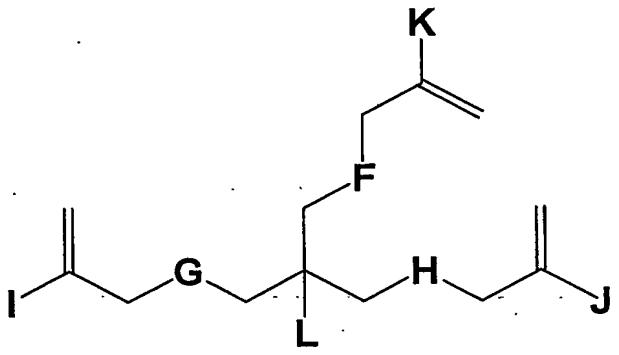
wherein

D represents a C_1-C_{30} alkyl, C_1-C_{30} aryl, C_3-C_{30} aralkyl, oxygen, sulphur, PEG, PPG or poly (THF); and

C and **E** represent independently an electron withdrawing group, an electron releasing group or a C_1-C_{30} aryl.

11. Cross-linked polyether according to any one of claims 1 to 8, wherein said monomer is copolymerized with a secondary cross-linker selected from the group consisting of a PEG, PPG, poly (THF), and a secondary cross-linker having at least an acrylamide or an methacrylamide) end group.

12. Cross-linked polyether according to any one of claims 1 to 8, wherein said monomer is copolymerized with a tertiary cross-linker of the general formula



wherein

F, G and **H** represent independently a C_1-C_{30} alkyl, C_1-C_{30} aryl, C_3-C_{30} aralkyl, oxygen, sulphur, PEG, PPG or poly (THF);

I, J and **K** represent independently an electron withdrawing group, an electron releasing group or a C_1-C_{30} aryl; and

L represents H, C_1-C_{30} alkyl, C_1-C_{30} aryl, C_3-C_{30} aralkyl, glycidyl, C_1-C_{30} alkylglycidyl, hydroxyl or an alcohol protecting group.

13. Cross-linked polyether according to any one of claims 1 to 8, wherein said monomer is copolymerized with a comb-like or a star-shaped cross-linker derivatized with a (α-X-methyl) vinyl-EWG, (α-X-methyl) vinyl-ERG or (α-X-methyl) vinyl-aryl, where X is oxygen, sulfur, PEG, PPG, or poly (THF); derivatives selected from the group consisting of acrylates, acrylamides, acrylonitriles, acroleins, vinyl ketones, vinyl chlorides, vinyl bromides, and

styrenes; or a PEG, PPG, or poly (THF) having at least an acrylamide or a methacrylamide end group.

14. Cross-linked polyether according any to one of claims 8, 10, 11, and 12, wherein said monomer is produced by the Baylis-Hillman reaction or by an acid catalysis from an alcohol and a vinyl derivative, in a dehydration process.

15. Cross-linked polyether according to claim 14, wherein said vinyl derivative is vinyl-EWG, vinyl-ERG or vinyl-aryl.

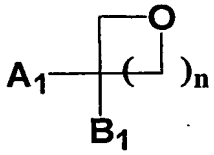
16. A cross-linked polyether which is obtained by polymerization of at least one monomer selected from the group consisting of

a) an α,α'-X-Y-epoxide, or an α,α'-X-Y-oxetane, where X is oxygen, sulfur, PEG, PPG, or poly (THF) and Y is selected from the group consisting of C_3 to C_{50} unsubstituted linear or branched alkanes, C_1 to C_{50} substituted linear or branched alkanes, C_3 to C_{50} unsubstituted linear or branched arylalkanes, C_2 to C_{50} substituted linear or branched arylalkanes, C_1 to C_{30} substituted or unsubstituted aryls;

b) a monomer which is polymerizable with a PEG, PPG or poly (THF) cross-linker having at least one α,α'-X-Y-epoxide or α,α'-X-Y-oxetane, where X is oxygen, sulfur, PEG, PPG or poly (THF), and Y is selected from the group consisting of C_3 to C_{50} unsubstituted linear or branched alkanes, C_1 to C_{50} substituted linear or branched alkanes, C_3 to C_{50} unsubstituted linear or branched arylalkanes, C_2 to C_{50} substituted linear or branched arylalkanes, C_1 to C_{30} substituted or unsubstituted aryls; and

c) mixtures thereof.

17. Cross-linked polyether according to claim 16, wherein said monomer is a polymerizable compound having the general formula



wherein

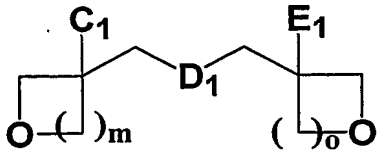
n = 0 or 1

A_1 H, C_1-C_{30} alkyl, C_1-C_{30} aryl, C_3-C_{30} aralkyl, PEG, PPG, poly (THF), hydroxyl, C_1-C_{30} alkyloxy, C_1-C_{30} hydroxyalkyl, amino, C_1-C_{30}, alkylamine, C_1-C_{30} aminoalkyl, formyl, C_1-C_{30} alkylaldehyde, thiol, C_1-C_{30} alkylthiol, halogen or an C_1-C_{30} halogenoalkyl; and

B_1 is selected from the group consisting of electron withdrawing groups, C_3 to C_{50} unsubstituted linear or branched alkanes, C_1 to C_{50} substituted linear or branched alkanes, C_3 to C_{50} unsubstituted linear or branched arylalkanes, C_2 to C_{50} substituted linear or branched arylalkanes, and C_1 to C_{30} substituted or unsubstituted aryls.

18. Cross-linked polyether according to claim 16 or 17, wherein said monomer is copolymerized with a PEG, PPG or poly (THF) based cross-linker.

19. Cross-linked polyether according to claim 16 or 17, wherein said monomer is copolymerized with a secondary cross-linker of the general formula



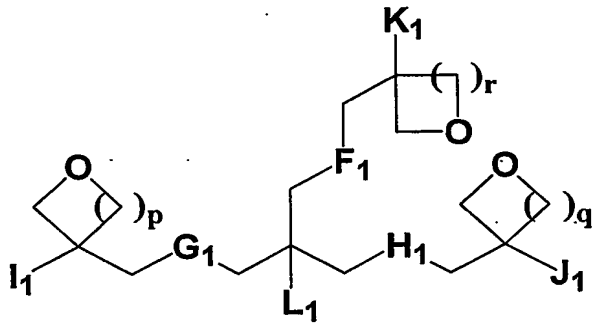
wherein

m and **o** are independently 0 or 1;

D_1 represents a C_1-C_{30} alkyl, C_1-C_{30} aryl, C_3-C_{30} aralkyl, oxygen, sulphur, PEG, PPG or poly (THF); and

C_1 and E_1 are independently selected from the group consisting of electron withdrawing groups, C_3 to C_{50} unsubstituted linear or branched alkanes, C_1 to C_{50} substituted linear or branched alkanes, C_3 to C_{50} unsubstituted linear or branched arylalkanes, C_2 to C_{50} substituted linear or branched arylalkanes, and C_1 to C_{30} substituted or unsubstituted aryls.

20. Cross-linked polyether according to claim 16 or 17, wherein said monomer is copolymerized with a tertiary cross-linker of the general formula



wherein

p, **q** and **r** are independently 0 or 1;

F_1, G_1 and H_1 represent independently a C_1-C_{30} alkyl, C_1-C_{30} aryl, C_3-C_{30} aralkyl, oxygen, sulphur, PEG, PPG or poly (THF);

I_1, J_1 and K_1 are independently selected from the group consisting of electron withdrawing groups, C_3 to C_{50} unsubstituted linear or branched alkanes, C_1 to C_{50} substituted linear or branched alkanes, C_3 to C_{50} unsubstituted linear or branched arylalkanes, C_2 to C_{50} substituted linear or branched arylalkanes, and C_1 to C_{30} substituted or unsubstituted aryls; and

L_1 represents H, C_1-C_{30} alkyl, C_2-C_{30} aryl, C_3-C_{30} aralkyl, glycidyl, C_1-C_{30} alkylglycidyl, hydroxyl or an alcohol protecting group.

21. Cross-linked polyether according to claim 16 or 17, wherein said monomer is copolymerized with a comb-like or a star-shaped cross-linker derivatized with an α,α'-X-Y-epoxide or an α,α'-X-Y-oxetane, where X is selected from the group consisting of oxygen, sulfur, PEG, PPG and poly (THF)); and Y is selected from the group consisting of C_3 to C_{50} unsubstituted linear or branched alkanes, C_1 to C_{50} substituted linear or branched alkanes, C_3 to C_{50} unsubstituted linear or branched arylalkanes, C_2 to C_{50} substituted linear or branched arylalkanes, and C_1 to C_{30} substituted or unsubstituted aryls.

22. Cross-linked polyether according to any one of claims 8, 10, 12, 17, 19 and 20 wherein functional groups **A, A_1, B, B_1, C, C_1, E, E_1, I, I_1, J, J_1, K, K_1** and **L, L_1** are chemically modified to provide linkers for organic, peptide, protein, nucleotide and saccharide synthesis, for the immobilisation of proteins and reagents, for chromatographic and scavenging purposes, as reverse phase packing and chromatographic devices, in ion exchange and normal phase chromatography.

23. Cross-linked polyether according to claim 22, wherein said linkers are selected from alcohol, C_1-C_{30} alkylalcohols, halogens, C_1-C_{30} halogenoalkyls, C_1-C_{30} hydroxyoalkyls, amines, C_1-C_{30} alkylamines, C_1-C_{30} alkylaminoalkyls, C_1-C_{30} aryls, C_1-C_{30} alkyls, C_3-C_{30} aralkyls, nitrile, C_1-C_{30} alkylnitriles, carboxylic acids, C_1-C_{30} carboxyalkyls, esters, C_1-C_{30} alkylesters, thiols, C_1-C_{30} alkylthiols, sulfos, C_1-C_{30} alkylsulfos, sulfinos, C_1-C_{30} alkylsulfinos, sulfenos, C_1-C_{30} alkylsulfenos, and derivatives thereof.

24. A method for the preparation of a cross-linked polyether, said method comprising the step of polymerizing of at least one monomer selected from the group consisting of

a) (α-X-methyl) vinyl-EWG, (α-X-methyl) vinyl-ERG, or (α-X-methyl) vinyl-aryl, where X is oxygen, sulfur, PEG, PPG or poly (THF);

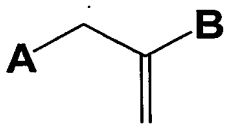
b) a monomer which is polymerizable with a PEG, PPG or poly (THF) cross-linker having at least one (α-X-methyl) vinyl-EWG, (α-X-methyl) vinyl-ERG or (α-X-methyl) vinyl-aryl, where X is oxygen, sulfur, PEG, PPG, or poly (THF);

c) a PEG, PPG, or poly (THF) cross-linker having at least an acrylamide or a methacrylamide end group; and

d) mixtures thereof.

25. Method according to claim 24, which comprises

a) copolymerizing a polymerizable monomer having the general formula



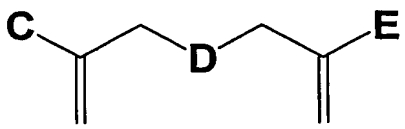
wherein

A represents H, C_1-C_{30} alkyl, C_1-C_{30} aryl, C_3-C_{30} aralkyl, PEG, PPG, poly (THF), hydroxyl, C_1-C_{30} alkyloxy, C_1-C_{30} hydroxyalkyl, amino, C_1-C_{30}, alkylamine, C_1-C_{30} aminoalkyl, formyl, C_1-C_{30} alkylaldehyde, thiol, C_1-C_{30} alkylthiol, halogen or an C_1-C_{30} halogenoalkyl;and

B represents an electron withdrawing group, an electron releasing group or an aryl;

together with

i) a secondary cross-linker of the general formula



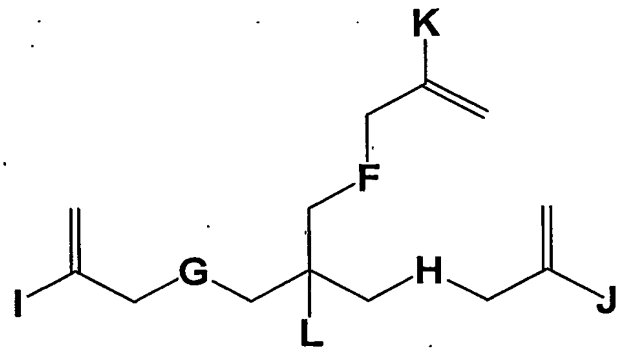
wherein

D represents a C_1-C_{30} alkyl, C_1-C_{30} aryl, C_3-C_{30} aralkyl, oxygen, sulphur, PEG, PPG or poly (THF);

C and **E** represent independently an electron withdrawing group, an electron releasing group or a C_1-C_{30} aryl;

ii) a PEG, PPG, or poly (THF) cross-linker having at least an acrylamide or a methacrylamide end group;

iii) a tertiary cross-linker of the general formula



wherein

F, G and **H** represent independently a C_1-C_{30} alkyl, C_1-C_{30} aryl, C_3-C_{30} aralkyl, oxygen, sulphur, PEG, PPG or poly (THF);

I, J and **K** represent independently an electron withdrawing group, an electron releasing group or a C_1-C_{30} aryl; and

L represents H, C_1-C_{30} alkyl, C_1-C_{30} aryl, C_3-C_{30} aralkyl, glycidyl, C_1-C_{30} alkylglycidyl, hydroxyl or an alcohol protecting group;

iv) a comb-like or a star-shaped cross-linker derivatized with a (α-X-methyl) vinyl-EWG, (α-X-methyl) vinyl-ERG or (α-X-methyl) vinyl-aryl, where X is oxygen, sulfur, PEG, PPG, or poly (THF); derivatives selected from the group consisting of acrylates, acrylamides, acrylonitriles, acroleins, vinyl ketones, vinyl chlorides, vinyl bromides, and styrenes; or a PEG, PPG, or poly (THF) having at least an acrylamide or a methacrylamide end group; or

v) divinylbenzene,

so as to obtain said polyether; and

b) chemically modifying said polyether so as to obtain a polyether derivative selected from the group consisting of aldehyde, amine, ketone, halogen, carboxylic acid, thiol, amide and or ester resin.

26. Method according to claim 25, wherein said cross-linked polyether is obtained by suspension radical polymerization.

27. Method according to claim 25, which comprises carrying said copolymerization in the presence of additional polymerizable monomers selected from the group consisting of styrene, acrylates, acrylamides, acrylonitriles, acroleins (and their methacrylic derivatives), vinyl ketones, vinyl chlorides or vinyl bromides.

28. Method according to claim 25, which comprises functionalizing said monomer with groups capable of anchoring linkers.

29. Method according to claim 24, which comprises functionalizing said acrylamide or methacrylamide monomer with groups capable of anchoring linkers.

30. Method according to claim 25, which comprises functionalizing said acrylamide or methacrylamide cross-linker with groups capable of anchoring linkers.

31. A method for the preparation of a cross-linked polyether, said method comprising the step of polymerizing of at least one monomer selected from the group consisting of

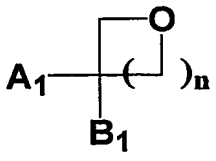
a) an α,α'-X-Y-epoxide, or an α,α'-X-Y-oxetane, where X is oxygen, sulfur, PEG, PPG, or poly (THF) and Y is selected from the group consisting of C_3 to C_{50} unsubstituted linear or branched alkanes, C_1 to C_{50} substituted linear or branched alkanes, C_3 to C_{50} unsubstituted linear or branched arylalkanes, C_2 to C_{50} substituted linear or branched arylalkanes, C_1 to C_{30} substituted or unsubstituted aryls;

b) a monomer which is polymerizable with a PEG, PPG or poly (THF) cross-linker having at least one α,α'-X-Y-epoxide or α,α'-X-Y-oxetane, where X is oxygen, sulfur, PEG, PPG or poly (THF), and Y is selected from the group consisting of C_3 to C_{50} unsubstituted linear or branched alkanes, C_1 to C_{50} substituted linear or branched alkanes, C_3 to C_{50} unsubstituted linear or branched arylalkanes, C_2 to C_{50} substituted linear or branched arylalkanes, C_1 to C_{30} substituted or unsubstituted aryls; and

c) mixtures thereof.

32. Method according to claim 31, which comprises

a) copolymerizing a polymerizable monomer having the general formula



wherein

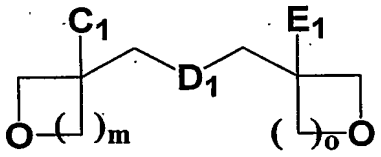
n = 0 or 1

A_1 H, C_1-C_{30} alkyl, C_1-C_{30} aryl, C_3-C_{30} aralkyl, PEG, PPG, poly (THF), hydroxyl, C_1-C_{30} alkyloxy, C_1-C_{30} hydroxyalkyl, amino, C_1-C_{30}, alkylamine, C_1-C_{30} aminoalkyl, formyl, C_1-C_{30} alkylaldehyde, thiol, C_1-C_{30} alkylthiol, halogen or an C_1-C_{30} halogenoalkyl; and

B_1 is selected from the group consisting of electron withdrawing groups, C_3 to C_{50} unsubstituted linear or branched alkanes, C_1 to C_{50} substituted linear or branched alkanes, C_3 to C_{50} unsubstituted linear or branched arylalkanes, C_2 to C_{50} substituted linear or branched arylalkanes, and C_1 to C_{30} substituted or unsubstituted aryls;

together with

i) a secondary cross-linker of the general formula



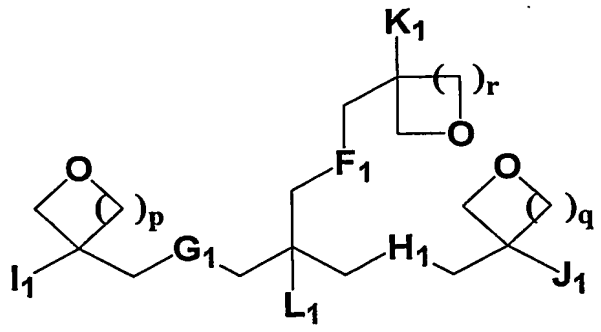
wherein

m and **o** are independently 0 or 1;

D_1 represents a C_1-C_{30} alkyl, C_1-C_{30} aryl, C_3-C_{30} aralkyl, oxygen, sulphur, PEG, PPG or poly (THF); and

C_1 and E_1 are independently selected from the group consisting of electron withdrawing groups, C_3 to C_{50} unsubstituted linear or branched alkanes, C_1 to C_{50} substituted linear or branched alkanes, C_3 to C_{50} unsubstituted linear or branched arylalkanes, C_2 to C_{50} substituted linear or branched arylalkanes, and C_1 to C_{30} substituted or unsubstituted aryls;

ii) a tertiary cross-linker of the general formula



wherein

p, **q** and **r** are independently 0 or 1;

$\mathbf{F_1}$, $\mathbf{G_1}$ and $\mathbf{H_1}$ represent independently a C_1-C_{30} alkyl, C_2-C_{30} aryl, C_3-C_{30} aralkyl, oxygen, sulphur, PEG, PPG or poly (THF);

$\mathbf{I_1}$, $\mathbf{J_1}$ and $\mathbf{K_1}$ are independently selected from the group consisting of electron withdrawing groups, C_3 to C_{50} unsubstituted linear or branched alkanes, C_1 to C_{50} substituted linear or branched alkanes, C_3 to C_{50} unsubstituted linear or branched arylalkanes, C_2 to C_{50} substituted linear or branched arylalkanes, and C_1 to C_{30} substituted or unsubstituted aryls; and

$\mathbf{L_1}$ represents H, C_1-C_{30} alkyl, C_2-C_{30} aryl, C_3-C_{30} aralkyl, glycidyl, C_1-C_{30} alkylglycidyl, hydroxyl or an C_1-C_{30} alkylol protecting group; or

iii) a comb-like or a star-shaped cross-linker derivatized with an α,α'-X-Y-epoxide or an α,α'-X-Y-oxetane, where X is selected from the group consisting of oxygen, sulfur, PEG, PPG and poly (THF)), and Y is selected from the group consisting of C_3 to C_{50} unsubstituted linear or branched alkanes, C_1 to C_{50} substituted linear or branched alkanes, C_3 to C_{50} unsubstituted linear or branched arylalkanes, C_2 to C_{50} substituted linear or branched arylalkanes, and C_1 to C_{30} substituted or unsubstituted aryls; and

b) chemically modifying said polyether so as to obtain a polyether derivative selected from the group consisting of aldehyde, amine, ketone, halogen, carboxylic acid, thiol, amide and or ester resin.

33. Method according to claim 32, wherein said cross-linked polyether is obtained by suspension cationic polymerization.

34. Method according to claim 32, which comprises carrying said copolymerization in the presence of additional polymerizable monomers selected from the group consisting of epoxides, oxetanes, vinyl and allyl ethers.

35. Method according to claim 25 or 32, which comprises synthesizing the cross-linked polyether into beaded form.

36. Method according to claim 31, which comprises functionalizing said α,α'-X-Y-epoxide or α,α'-X-Y-oxetane monomer with groups capable of anchoring linkers.

37. Method according to claim 32, which comprises functionalizing said α,α'-X-Y-epoxide or α,α'-X-Y-oxetane cross-linker with groups capable of anchoring linkers.

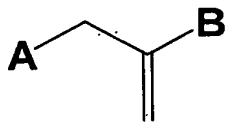
38. Method according to any one of claims 29, 30, 36 and 37, wherein said groups are selected from aldehydes, alcohols, halogens, ketones, amino, and phenyl groups which can be derivatized into said anchoring linkers.

39. Method according to claim 35, which comprises forming, said beads by normal or inverse suspension.

40. Method according to claim 32, which comprises carrying said copolymerization in the presence of additional polymerizable monomers selected from the group consisting of epoxides, oxetanes, vinyl and allyl ethers.

41. Monomers or cross-linkers as defined in any one of claims 1 to 23.

42. A compound of formula

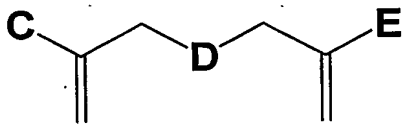


wherein

A is PEG, PPG, poly (THF), hydroxyl, C_1-C_{30} alkyloxy, C_1-C_{30} hydroxyalkyl, amino, C_1-C_{30}, alkylamine, C_1-C_{30} aminoalkyl, formyl, C_1-C_{30} alkylaldehyde, thiol, C_1-C_{30} alkylthiol, halogen or C_1-C_{30} halogenoalkyl; and

B represents an electron withdrawing group, an electron releasing group or an aryl.

43. A compound of formula

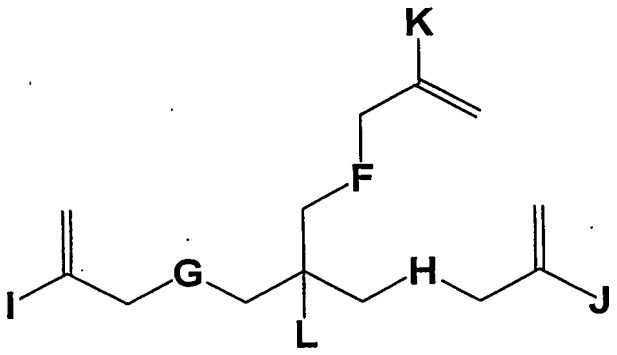


wherein

D is PEG, PPG or poly (THF); and

C and **E** represent independently an electron withdrawing group, an electron releasing group or a C_1-C_{30} aryl.

44. A compound of formula



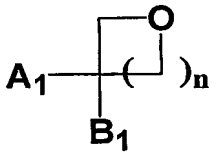
wherein

F, G and **H** represent independently PEG, PPG or poly (THF);

I, J and **K** represent independently an electron withdrawing group, an electron releasing group or a C_1-C_{30} aryl; and

L represents H, C_1-C_{30} alkyl, C_1-C_{30} aryl, C_3-C_{30} aralkyl, glycidyl, C_1-C_{30} alkylglycidyl, hydroxyl or an alcohol protecting group.

45. A compound of formula



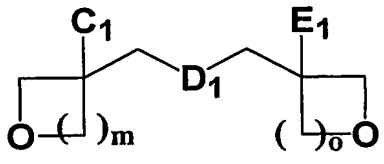
wherein

n = 0 or 1

$\mathbf{A_1}$ represents PEG, PPG, poly (THF); and

$\mathbf{B_1}$ is selected from the group consisting of electron withdrawing groups, C_3 to C_{50} unsubstituted linear or branched alkanes, C_1 to C_{50} substituted linear or branched alkanes, C_3 to C_{50} unsubstituted linear or branched arylalkanes, C_2 to C_{50} substituted linear or branched arylalkanes, and C_1 to C_{30} substituted or unsubstituted aryls.

46. A compound of formula



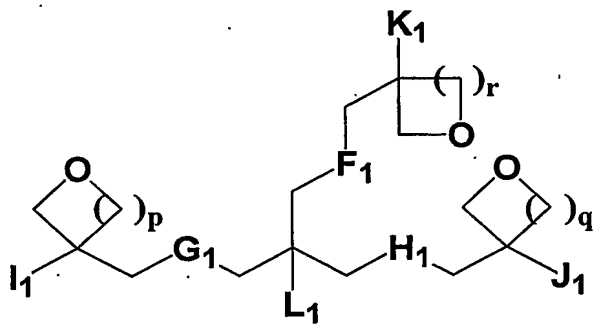
wherein

m and **o** are independently 0 or 1;

$\mathbf{D_1}$ represents PEG, PPG or poly (THF); and

$\mathbf{C_1}$ and $\mathbf{E_1}$ are independently selected from the group consisting of electron withdrawing groups, C_3 to C_{50} unsubstituted linear or branched alkanes, C_1 to C_{50} substituted linear or branched alkanes, C_3 to C_{50} unsubstituted linear or branched arylalkanes, C_2 to C_{50} substituted linear or branched arylalkanes, and C_1 to C_{30} substituted or unsubstituted aryls.

47. A compound of formula



wherein

p, **q** and **r** are independently 0 or 1;

$\mathbf{F_1}$, $\mathbf{G_1}$ and $\mathbf{H_1}$ represent independently PEG, PPG or poly(THF);

$\mathbf{I_1}$, $\mathbf{J_1}$ and $\mathbf{K_1}$ are independently selected from the group consisting of electron withdrawing groups, C_3 to C_{50} unsubstituted linear or branched alkanes,

C_1 to C_{50} substituted linear or branched alkanes, C_3 to C_{50} unsubstituted linear or branched arylalkanes, C_2 to C_{50} substituted linear or branched arylalkanes, and C_1 to C_{30} substituted or unsubstituted aryls; and

L_1 represents H, C_1-C_{30} alkyl, C_2-C_{30} aryl, C_3-C_{30} aralkyl, glycidyl, C_1-C_{30} alkylglycidyl, hydroxyl or an alcohol protecting group.

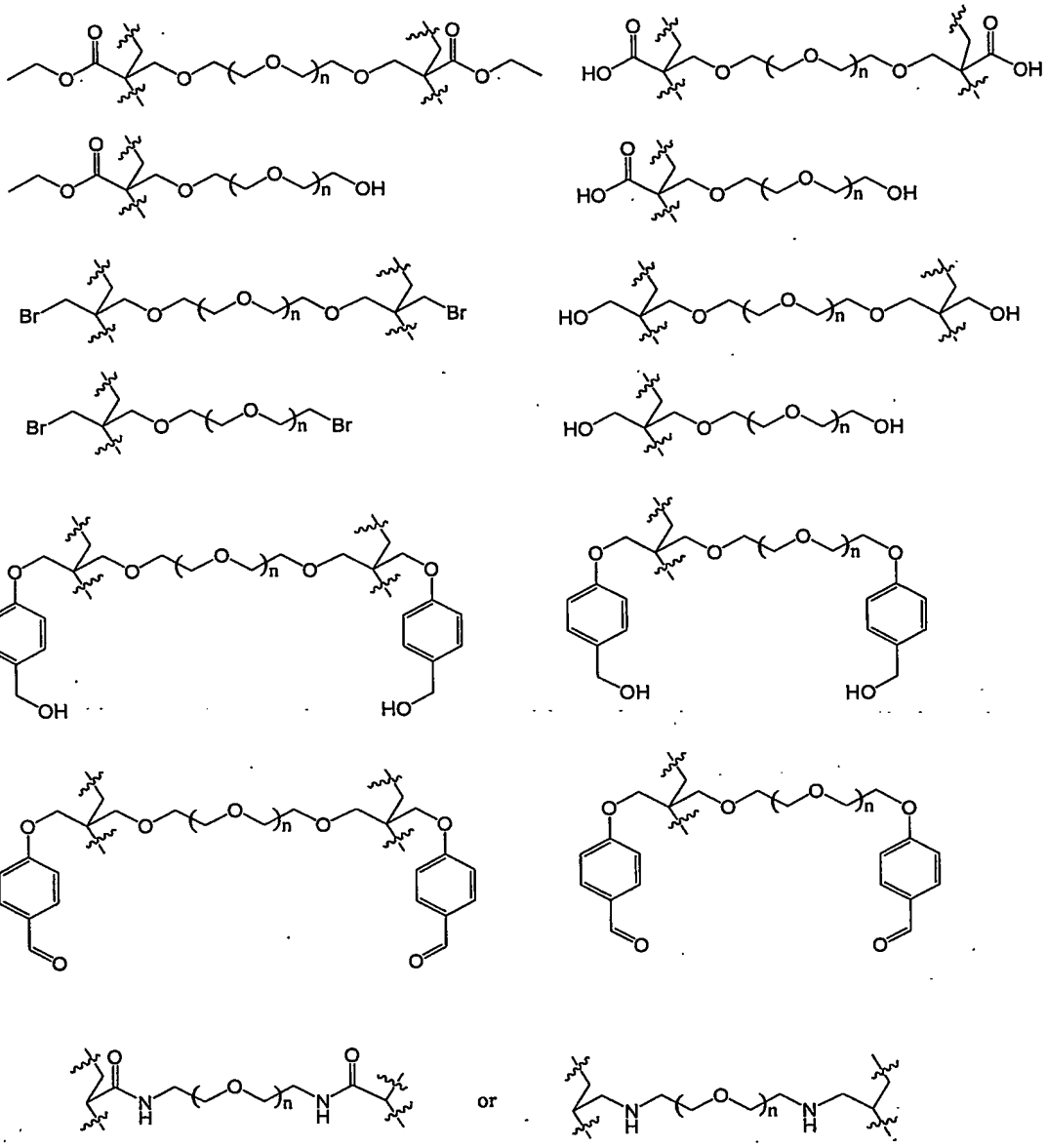
48. Use of a compound as defined in any one of claims 42 to 47, for preparing a polyether polymer.

49. Use of a compound as defined in any one of claims 42 to 47, for preparing a cross-linked polyether resin.

50. Use of a compound as defined in any one of claims 42 to 47, for preparing a polymeric support for use in bioorganic or organic chemistry.

51. Use of a compound as defined in any one of claims 43 to 47, as a cross-linker.

52. A cross-linked polyether resin comprising a unit of formula



or

wherein n has a value of 1 to 100.